IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

INVENTORS:	Norihiko SAITO et al.
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TITLE:	DIAGNOSTIC APPARATUS AND DIAGNOSTIC METHOD FUEL CELL
ART UNIT:	1745
EXAMINER:	Tony CHUO

Mail Stop Appeal Brief - Patents
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APPEAL BRIEF

SIR:

This is a brief in support of an appeal filed in the above-identified application.

I. Real Party in Interest

The real parties interest is the Assignee, Toyota Jidosha Kabushiki Kaisha.

II. Related Appeals and Interferences

There are no other appeals or interferences known to Appellant, Appellant's legal representative, or Assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in this Appeal.

III. Status of Claims

Claims 1-19 were originally filed in the application on November 19, 2003. No claims were canceled. Claims 1-19 are finally rejected and on appeal.

IV. Status of Amendments

No amendments were filed subsequent to final rejection.

V. Summary of Claimed Subject Matter

Independent claim 1.

A diagnostic apparatus for a fuel cell, which diagnoses a state of the fuel cell, comprising:

an operation device which is used for operating the fuel cell;

an operational state detecting portion which detects a change in an operational state of the fuel cell;

a device control portion which controls the operation device such that the fuel cell is operated according to at least one predetermined operation pattern, the predetermined operation pattern to apply at least one predetermined operating condition to change an operational state of the fuel cell; and

a diagnostic portion which diagnoses the state of the fuel cell based on the change in the operational state of the fuel cell that is detected by the operational state detecting portion when the fuel cell is operated by the device control portion according to the at least one predetermined operation pattern.

Explanation.

Embodiments of the present invention relate to improvements in a diagnostic apparatus for a fuel cell. Generally, in operation, the diagnostic apparatus according to the present invention may be connected to a vehicle operation control unit of a vehicle (claimed as "operation device") and other systems of the vehicle, and apply predetermined operation patterns to diagnose a state of a fuel cell of the vehicle (specification at, e.g., page 2, par. [0008]). Specifically, the diagnostic apparatus, through connections with the vehicle

operation control unit and the other vehicle systems, may change a particular operation condition while keeping others constant or within desired ranges, to place the fuel cell in a particular operating state (specification at, e.g., page 12, par. [0044]). Then, the diagnostic apparatus may compare detected performance values (e.g.,. voltage and current) with those of a normally functioning fuel cell in the same state, to determine whether the detected values are within an allowable range (specification at, e.g., page 12, par. [0044])

To accomplish the above, the diagnostic apparatus may comprise a control unit including a microcomputer, and units for attachment to vehicle systems (specification at, e.g., page 9, par. [0037] and page 10, par. [0041]; FIG. 1, control unit 60). The diagnostic apparatus control unit may include an operation control portion (claimed as "device control portion"), a diagnostic portion, and a unit control portion (specification at, e.g., page 10, par. [0041]; FIG. 1, portions 61-63). The diagnostic apparatus control unit may be connectable to the vehicle operation control unit, and control operation of the vehicle's fuel cell by way of the vehicle operation control unit (specification at, e.g., page 10, par. [0041]; FIG. 3, connector 69).

The units for attachment to other vehicle systems may include a power adjustment unit, a cooling unit and a fuel gas supply unit (specification at, e.g., page 9, par. [0037]; FIG. 1, power adjustment unit 40, cooling unit 50, fuel gas supply unit 30). These units may be connectable to corresponding vehicle systems, i.e., a power adjustment system, a cooling system and a fuel gas supply system, respectively (specification at, e.g., pages 9-10, pars. [0038-0040]; FIG. 3, connectors 39, 49, 59). The units of the diagnostic apparatus attached to the vehicle systems may be used to apply predetermined operation patterns for diagnosis of the vehicle's fuel cell (specification at, e.g., pages 10-11, par. [0042]).

Specifically, as noted previously, the predetermined operation patterns may change an operational state of the fuel cell. For example, in one predetermined operation pattern, the fuel gas supply unit, the power adjustment unit and the cooling unit may be connected to the corresponding vehicle

systems. After the units have operated so that the fuel cell is performing its function in a steady state, the power adjustment unit may be operated to change the current I generated by the fuel cell. The voltage V resulting from the change in the current may be detected, and it may be determined, by comparing the IV relationship under the applied predetermined operation pattern with an IV characteristic of the fuel cell as it normally functions, whether a deviation in the former from the latter is within an acceptable range. (Specification at, e.g., page 12, par. [0044]).

Other attachments for other predetermined operation patterns are possible (specification at, e.g., pages 10-11, par. [0042]). For each pattern, the diagnostic apparatus may execute a process to perform a plurality of checks based on behavior of the fuel cell caused by a change in its operational state due to the applied pattern, and then an overall diagnosis of the state of the fuel cell may be performed based on the results of the checks (specification at, e.g., pages 11-12, par. [0043]). Advantages of the diagnostic apparatus according to the present invention include a capability to more accurately diagnose a state of a fuel cell as compared to prior art (specification at, e.g., pages 5-6, pars. [0020]-[0023]).

Independent claim 16.

A diagnostic method for a fuel cell, which is a method for diagnosing a state of the fuel cell, includes the steps of:

(a) operating the fuel cell according to at least one predetermined operation pattern, the predetermined operation pattern to apply at least one predetermined operating condition to change an operational state of the fuel cell;

(b) detecting a change in an operational state of the fuel cell corresponding to each of the operation patterns when the fuel cell is operated according to the at least one predetermined operation pattern; and

(c) diagnosing the state of the fuel cell based on the detected change in the operational state and the at least one predetermined operation pattern.

Explanation.

The explanation of claim 16 is substantially the same as that for claim 1.

VI. Grounds of Rejection to be Reviewed on Appeal

A. Claims 1-7, 11 and 16-19 are rejected under 35 USC 103(a) as being unpatentable over Fuglevand et al. (US 6,096,449) ("Fuglevand").

B. Claims 8-10 are rejected under 35 USC 103(a) as being unpatentable over Fuglevand in view of Bai et al. (US 6,620,538) ("Bai").

C. Claims 12-14 are rejected under 35 USC 103(a) as being unpatentable over Fuglevand in view of Iwasaki (US 6,447,939) .

D. Claim 15 is rejected under 35 USC 103(a) as being unpatentable over Fuglevand in view of Iwasaki, and further in view of Yoshizawa et al. (US 2003/0003334) ("Yoshizawa").

VII. Argument

A. Claims 1-7, 11 and 16-19 are allowable over Fuglevand.

Fuglevand does not disclose or suggest that a fuel cell is operated according to at least one predetermined operation pattern, the predetermined operation pattern to apply at least one predetermined operating condition to change an operational state of the fuel cell, as recited in independent claims 1 and 16.

In the final Office Action mailed July 3, 2006 (hereafter, "Office Action"), the Examiner asserts that "Fuglevand ... discloses predetermined performance parameters that are determined by operational history of the fuel cell (See column 8, lines 9-15. These predetermined performance parameters are

equivalent to the predetermined operation patterns claimed by the applicant" (Office Action, page 2, item 3, lines 3-6). This is error: the performance parameters of Fuglevand are in no way the equivalent of the predetermined operation patterns of the claims on appeal.

Fuglevand's system is for shunting current around non-performing cells; it is not a diagnostic system as is the present invention. For example, the "predetermined performance parameters" of Fuglevand do not *apply at least one predetermined operating condition to change* an operational state of the fuel cell as required by the present claims. Instead, they are a *measurement* of a state of a fuel cell to determine whether to shunt around it. The Examiner concedes this point, noting that (as quoted above) "Fuglevand ... discloses predetermined parameters that are determined by *an operational history* of the fuel cell ... " (emphasis added). An "operational history" by definition is a record of past operation, not a present operation to change an operational state.

Fuglevand could not be more clear regarding the above. See, for example, col. 8, lines 9-31:

> "In the first and second operational conditions which are described herein, the predetermined performance parameters of the individual and serially electrically coupled fuel cells 10 comprise selected current and voltage outputs of the fuel cell 10. These **predetermined threshold performance parameters** may be determined by various means including but not limited to, experiment; **operational history** or electrical load, for example. Additionally, the predetermined performance parameters might include, in the first condition, for example, where the **performance parameters** of the fuel cell are just merely or generally **declining over a given time interval**; are declining or in a range of less than about 0.4 volts; or are **declining or degrading**, generally speaking in relative relation to the performance parameters of other fuel cells 10 with which it is serially electrically coupled. This list of possible **parameters** is not all inclusive and many other physical and operational parameters could be monitored, and which would tend to **suggest that a selected fuel cell is beginning to fail, and should be disconnected from the stack for repair or replacement if the**

> **shortcoming in performance is severe, or on the other hand subjected to increased shunting** to determine if the fuel cell 10 can be recovered back to the predetermined performance parameters selected."

(Emphasis added.) In view of the above, the performance parameters of Fuglevand clearly have nothing to do with actively changing an operational state of a fuel cell for diagnosing the fuel cell. Instead, they are merely values representing a past performance, to determine whether or not to replace or shunt around failing cells.

In the Advisory Action mailed August 17, 2006, the Examiner argues as follows:

> "In response to the applicant's argument that the 'predetermined performance parameters' of Fuglevand do not change an operational state of the fuel cell as required by the present claims, the operational state of the fuel cell, i.e. on/off, is changed in response to the predetermined performance parameters of Fuglevand by determining whether to turn the fuel cell on or off. Therefore, the present claims still read on the Fuglevand reference because the 'predetermined performance parameters' taught by Fuglevand is equivalent to the 'predetermined operation pattern' of the applicant."

(Page 2, section headed "Response to Arguments.") This is further error. Fuglevand's performance parameters do not change an operational state, they merely record it. The fact that some operation may be performed based on the information in the parameters does not mean that the parameters themselves are capable of changing an operational state. In particular, Fuglevand's parameters are not an operating condition *applied* to change an operational state, as required by the claims on appeal; instead, they are only passively collected.

In any case, the claims on appeal recite more than "predetermined operation patterns." Claim 1, for example, further recites "*a device control portion which controls the operation device* such that the fuel cell is operated according to at least one predetermined operation pattern ... " (emphasis added). As explained above, the claimed device control portion is part of a diagnostic

apparatus control unit that controls a vehicle operation control unit so that the fuel cell is operated according to a predetermined operation pattern. The Examiner has not cited anything in the prior art corresponding to the claimed device control portion. It is evident in view of the above discussion that Fuglevand does not suggest any such device control portion, since the predetermined performance parameters are merely information, not an operation pattern that is actively applied.

Moreover, the claims further recite "a diagnostic portion which diagnoses the state of the fuel cell based on the change in the operational state of the fuel cell that is detected by the operational state detecting portion when the fuel cell is operated by the device control portion according to the at least one predetermined operation pattern" (claim 1) and "diagnosing the state of the fuel cell based on the detected change in the operational state and the at least one predetermined operation pattern" (claim 16). The Examiner cites Fuglevand at col. 2, lines 41-45 as corresponding to the noted features (Office Action, page 3, lines 2-4). This is still further error. There is nothing in the cited portion of Fuglevand, nor, indeed, in its entirety, that suggests detecting a change based on the purposeful application of an operational pattern that changes an operating condition, as required by the noted recitations. Instead, Fuglevand merely collects values representing performance and makes a decision based on the values.

For at least the above reasons, independent claims 1 and 16 are allowable over Fuglevand. Furthermore, dependent claims 2-7, 11 and 17-19 are likewise allowable over Fuglevand for at least the reason that they depend on one of claims 1 or 16.

B. Claims 8-10 are allowable over Fuglevand in view of Bai.

Claims 8-10 depend on claim 1 and are therefore allowable over Fuglevand for at least that reason. Bai does not cure the deficiencies in Fuglevand with respect to claim 1, and therefore claims 8-10 are further allowable over the combination of Fuglevand and Bai.

C. Claims 12-14 are allowable over Fuglevand in view of Iwasaki.

Claims 12-14 depend on claim 1 and are therefore allowable over Fuglevand for at least that reason. Iwasaki does not cure the deficiencies in Fuglevand with respect to claim 1, and therefore claims 12-14 are further allowable over the combination of Fuglevand and Iwasaki.

D. Claim 15 is allowable over Fuglevand in view of Iwasaki, and further in view of Yoshizawa.

Claim 15 depends on claim 1 and is therefore allowable over Fuglevand for at least that reason. Iwasaki and Yoshizawa do not cure the deficiencies in Fuglevand with respect to claim 1, and therefore claim 15 is further allowable over the combination of Fuglevand, Iwasaki and Yoshizawa.

Conclusion

In view of the above, it is abundantly clear that the Examiner erred in finally rejecting claims 1-19. It is therefore respectfully requested that the Board reverse the Examiner and allow claims 1-19.

The Examiner is invited to contact the undersigned at (202) 220-4323 to discuss any matter concerning this application. The Office is authorized to charge any fees related to this communication to Deposit Account No. 11-0600.

Respectfully submitted,

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CLAIMS APPENDIX

1. A diagnostic apparatus for a fuel cell, which diagnoses a state of the fuel cell, comprising:

an operation device which is used for operating the fuel cell;

an operational state detecting portion which detects a change in an operational state of the fuel cell;

a device control portion which controls the operation device such that the fuel cell is operated according to at least one predetermined operation pattern, the predetermined operation pattern to apply at least one predetermined operating condition to change an operational state of the fuel cell; and

a diagnostic portion which diagnoses the state of the fuel cell based on the change in the operational state of the fuel cell that is detected by the operational state detecting portion when the fuel cell is operated by the device control portion according to the at least one predetermined operation pattern.

2. The diagnostic apparatus for a fuel cell according to claim 1, wherein the diagnostic portion diagnoses the state of the fuel cell by comparing the change in the operational state of the fuel cell corresponding to each of the operation patterns, which is detected by the operational state detecting portion when the fuel cell is operated by the device control portion according to the at least one predetermined operation pattern, with a change in a normal operational state of a normally functioning fuel cell operated according to the same at least one predetermined operation pattern.

3. The diagnostic apparatus for a fuel cell according to claim 2, wherein a relationship between the state of the fuel cell, and presence or absence of an abnormality in the change in the operational state of the fuel cell corresponding to each of the operation patterns is set in the diagnostic portion in advance.

4. The diagnostic apparatus for a fuel cell according to claim 1, wherein the operational state detecting portion detects, as the operational state of the fuel cell, an output current and an output voltage of the fuel cell, and the diagnostic portion diagnoses the state of the fuel cell based on the detected output current and the detected output voltage.

5. The diagnostic apparatus for a fuel cell according to claim 1, wherein the operational state detecting portion detects, as the operational state of the fuel cell, an interterminal voltage and/or a cell voltage when the fuel cell is in an open state, and the diagnostic portion diagnoses the state of the fuel cell based on the detected interterminal voltage and/or the detected cell voltage.

6. The diagnostic apparatus for a fuel cell according to claim 1, wherein the operation device is a gas supply device which is used for supplying a fuel gas and/or an oxidative gas to the fuel cell, and the device control portion controls, according to one of the at least one predetermined operation pattern, the gas supply device such that the fuel gas and/or the oxidative gas is supplied to the fuel cell according to a predetermined supply pattern.

7. The diagnostic apparatus for a fuel cell according to claim 6, wherein the predetermined supply pattern includes one of a predetermined pattern of increasing/decreasing a flow amount of the fuel gas and/or the oxidative gas, a predetermined pattern of increasing/decreasing a supply pressure, and a predetermined pattern of increasing/decreasing a degree of humidification.

8. The diagnostic apparatus for a fuel cell according to claim 1, wherein the operational state detecting portion detects, as the operational state of the fuel cell, an internal resistance of the fuel cell, and the diagnostic portion diagnoses the state of the fuel cell based on the detected internal resistance.

9. The diagnostic apparatus for a fuel cell according to claim 1, wherein the operation device is a temperature adjusting device which is used for adjusting an operation temperature of the fuel cell, and the device control portion controls, according to one of the at least one predetermined operation pattern, the temperature adjusting device such that the fuel cell is operated according to a predetermined temperature pattern.

10. The diagnostic apparatus for a fuel cell according to claim 1, wherein the operational state detecting portion detects, as the operational state of the fuel cell, one of a temperature of the fuel cell, an exhaust gas temperature in a fuel gas system, and an exhaust gas temperature in an oxidative gas system, and the diagnostic portion diagnoses the state of the fuel cell based on one of the temperature of the fuel cell, the exhaust gas temperature in the fuel gas system, and the exhaust gas temperature in the oxidative gas system, which is detected.

11. The diagnostic apparatus for a fuel cell according to claim 1, wherein the diagnostic portion determines that there is a mechanical failure or deterioration due to a secular change when an output voltage of the fuel cell is less than a predetermined value in a case where the fuel cell is operated according to the at least one predetermined operation pattern.

12. The diagnostic apparatus for a fuel cell according to claim 1, which diagnoses a state of a fuel cell installed in a moving object as a power source, wherein the operation device includes a device installed in the moving object, the operational state detecting portion includes a moving object detecting portion which is installed in the moving object, and which detects a state as the operational state of the fuel cell, the device control portion can be connected to a control system which is installed in the moving object for controlling an operation of the fuel cell, and controls the operation device by giving an instruction to the control system, and the operation device includes a power adjusting portion which adjusts power generated by the fuel cell.

13. The diagnostic apparatus for a fuel cell according to claim 12, wherein the power adjusting portion is connected to an output terminal of the fuel cell, and adjusts the power generated by the fuel cell by absorbing or consuming the power.

14. The diagnostic apparatus for a fuel cell according to claim 12, further comprising:

a fuel gas supply portion which supplies the fuel cell with a fuel gas that is used for power generation of the fuel cell, instead of a fuel gas supply system which is installed in the moving object for supplying the fuel cell with the fuel gas.

15. The diagnostic apparatus for a fuel cell according to claim 12, further comprising:

a cooling portion which cools the fuel cell, instead of a cooling system which is installed in the moving object for cooling the fuel cell.

16. A diagnostic method for a fuel cell, which is a method for diagnosing a state of the fuel cell, includes the steps of:

(a) operating the fuel cell according to at least one predetermined operation pattern, the predetermined operation pattern to apply at least one predetermined operating condition to change an operational state of the fuel cell;

(b) detecting a change in an operational state of the fuel cell corresponding to each of the operation patterns when the fuel cell is operated according to the at least one predetermined operation pattern; and

(c) diagnosing the state of the fuel cell based on the detected change in the operational state and the at least one predetermined operation pattern.

17. The diagnostic method for a fuel cell according to claim 16, wherein in the step (c), the state of the fuel cell is diagnosed by comparing the change in the

operational state of the fuel cell corresponding to each of the operation patterns, which is detected when the fuel cell is operated according to the at least one predetermined operation pattern, with a change in a normal operational state of the fuel cell corresponding to each of the operation patterns, which is detected when the fuel cell that normally functions is operated according to the at least one predetermined operation pattern.

18. The diagnostic method for a fuel cell according to claim 16, wherein in the step (a), the fuel cell is operated according to one of a predetermined pattern of increasing/decreasing a flow amount of a fuel gas and/or an oxidative gas that is supplied to the fuel cell, a predetermined pattern of increasing/decreasing a supply pressure, and a predetermined pattern of increasing/decreasing a degree of humidification, as one of the operation patterns.

19. The diagnostic method for a fuel cell according to claim 16, wherein in the step (b), one of i) an output current and an output voltage of the fuel cell, ii) an interterminal voltage or a cell voltage when the fuel cell is in an open state, iii) an internal resistance of the fuel cell; iv) a temperature of the fuel cell, v) an exhaust gas temperature in a fuel gas system of the fuel cell, vi) and an exhaust gas temperature in an oxidative gas system of the fuel cell is detected as the operational state.

EVIDENCE APPENDIX

No evidence has been submitted.

RELATED PROCEEDINGS APPENDIX

There are no related proceedings.